299-W22-85 (C3399)

Log Data Report

Borehole Information:

Borehole:	299-W22-85 (C3399)		Site:	East of SX Tank Farm	
Coordinates (Plant)		GWL (ft)[1]: 222.5		GWL Date:	10/09/01
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
		Oct. 2001	Unknown	260	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel threaded	2.0	11 3/4	10 3/4	0.5	2.0	260

Borehole Notes:

The logging engineer measured the pipe stickup at the borehole using a steel tape.

Logging Equipment Information:

Logging System:	RLS-1	Type:	HPGe (70%)
Calibration Date:		Calibration Reference:	
		Logging Procedure:	MAC-HGLP 1.6.5

Logging System:	RLS-1	Type:	Moisture
Calibration Date:	07/01	Calibration Reference:	RLSM00.0 (Randall 2001)
		Logging Procedure:	MAC-HGLP 1.6.5

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4
Date	10/10/01	10/10/01	10/10/01	
Logging Engineer	Spatz	Spatz	Spatz	
Start Depth (ft)	260.0	97.0	70.0	
Finish Depth (ft)	71.0	71.0	2.0	
Count Time (sec)	100	100	100	
Live/Real	R	R	R	
Shield (Y/N)	N/A[3]	N/A	N/A	
MSA Interval (ft)	1.0	1.0	1.0	
ft/min	N/A	N/A	N/A	
Pre-Verification	B0581CAB	B0581CAB	B0581CAB	
Start File	B0581000	B0581190	B0581217	
Finish File	B0581189	B0581216	B0581285	
Post-Verification	B0581CAA	B0581CAA	B0581CAA	
Depth Return Error (ft)	0	N/A	0	
Comments	Fine-gain adjustments	Repeat section	Fine-gain adjustments	

Neutron Moisture Logging System (NMLS) Run Information:

Log Run	1	2	3	4
Date	10/09/01	10/09/01		
Logging Engineer	Spatz	Spatz		
Start Depth (ft)	0	222.75		
Finish Depth (ft)	222.5	199.0		
Count Time (sec)	N/A	N/A		
Live/Real	R	R		
Shield (Y/N)	N/A	N/A		
MSA Interval (ft)	0.25	0.25		
ft/min	1.0/min	1.0/min		
Pre-Verification	C0232CAB	C0232CAB		
Start File	C0232000	CR232000		
Finish File	C0232890	CR232095		
Post-Verification	CR232CAA	CR232CAA		
Depth Return Error (ft)	N/A	0		
Comments	None	Repeat section		

Logging Operation Notes:

Zero reference is the top of ground surface, and log depths are relative to ground level. The sonde is centralized in the borehole for both the SGLS and NMLS.

A longer count time (200 sec) was required with the SGLS because of the relatively thick casing. The borehole was logged in the drill pipe before completion as a groundwater monitoring well. In order to obtain reliable spectra while minimizing overall logging time, the depth interval was increased from 0.5 to 1.0 ft.

The MCA's fine-gain stabilization feature is not enabled on the RLS-1 logging system. Fine-gain adjustments were made after files B0581003 (257 ft), B0581013 (247 ft), B0581019 (241 ft), B0581021 (239 ft), B0581050 (210 ft), and B0581160 (100 ft) during SGLS logging run 1. Log run 1 was terminated to refill the sonde with liquid nitrogen. Fine-gain adjustment was made after file B0581228 (59 ft) during SGLS logging run 3. Fine gain adjustments were not necessary during SGLS logging run 2. Pre- and post-survey verification spectra were collected using the 082 Amersham verifier.

Analysis Notes:

Analyst:	Sobczyk	Date:	10/18/01	Reference:	MAC-VZCP 1.7.9 Rev. 2

Pre-run and post-run verification spectra for the SGLS were evaluated. The acceptance criteria for field verification of the RLS-1 logging system are in the process of being established. Examinations of spectra indicate that the detector appears to have functioned normally during the log run, and the log data are provisionally accepted, subject to further review and analysis.

Individual SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL. Corrections were applied for a casing thickness of 0.5 in. from the ground surface to 260 ft. A correction for water in the borehole was applied below 222.5 ft; this depth was determined from the neutron log. Dead time corrections were not applied. Typically, dead time varied between 5 and 8 percent with the maximum amount of dead time (11 percent) occurring at 256 ft. The rerun of the RLS-1 showed good repeatability.

Pre-run and post-run verification spectra for the neutron tool were evaluated. The pre-survey verification spectrum (file C0232CAB) recorded 725 gross cps while the post-survey verification spectrum (file CR232CAA) recorded 741 gross cps.

Moisture calibration models at Hanford for 11-in. holes with 1/2-in. casing have not been established. Thus, the neutron log was not processed to estimate volumetric moisture content because the relatively large borehole diameter and casing thickness are beyond the range of conditions for which the tool was calibrated. Neutron data are presented as gross counts. In general, an increase in neutron count is indicative of an increase in moisture content, but a quantitative calculation of volumetric moisture cannot be made at this time. The rerun of the neutron-moisture tool showed good repeatability with the exception that the two runs appear to be off-depth. This apparent discrepancy is due to acquiring data in continuous mode in different directions. During the original log, data were acquired while going deeper into the hole, and the data are shifted upward about 1.5 in. During the repeat logging, data were acquired while coming out of the hole, and the data are shifted downward about 1.5 in. Regardless of the logging direction, the depth error is small (1.5 in.).

Log Plot Notes:

Separate log plots are provided for gross gamma, naturally occurring radionuclides (^{40}K, ^{232}Th, ^{238}U, and associated decay progeny), and man-made radionuclides. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing and water corrections. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. A gross neutron log of neutron counts is also shown on the combination plot.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected. ^{137}Cs activity was detected near the ground surface at a log depth of 4 ft. The measured ^{137}Cs activity was about 0.2 pCi/g.

The changes in gross gamma counts depend primarily upon changes in ^{40}K activities. The increase in gross gamma counts from about 180 cps to about 230 cps at a log depth of 53 ft corresponds with an increase in apparent ^{40}K activity from about 12 to 17 pCi/g. This increase in total gamma is interpreted as the Hanford H2. The increase in ^{232}Th activity from about 0.8 to 1.0 pCi/g and the increase in gross gamma counts from 250 to 280 cps near 120 ft are tentatively picked to represent the top of the Early Palouse Soil. The transition between the Hanford and Early Palouse Soil is gradational as opposed to abrupt. On the basis of low K-40 activities, the carbonate-rich paleosols of the Pliocene-Pleistocene are interpreted as being between 150 and 159 ft. The caliche layer with characteristically high uranium content (greater than 2.0 pCi/g) is absent. The top of the Ringold is picked at 159 ft.

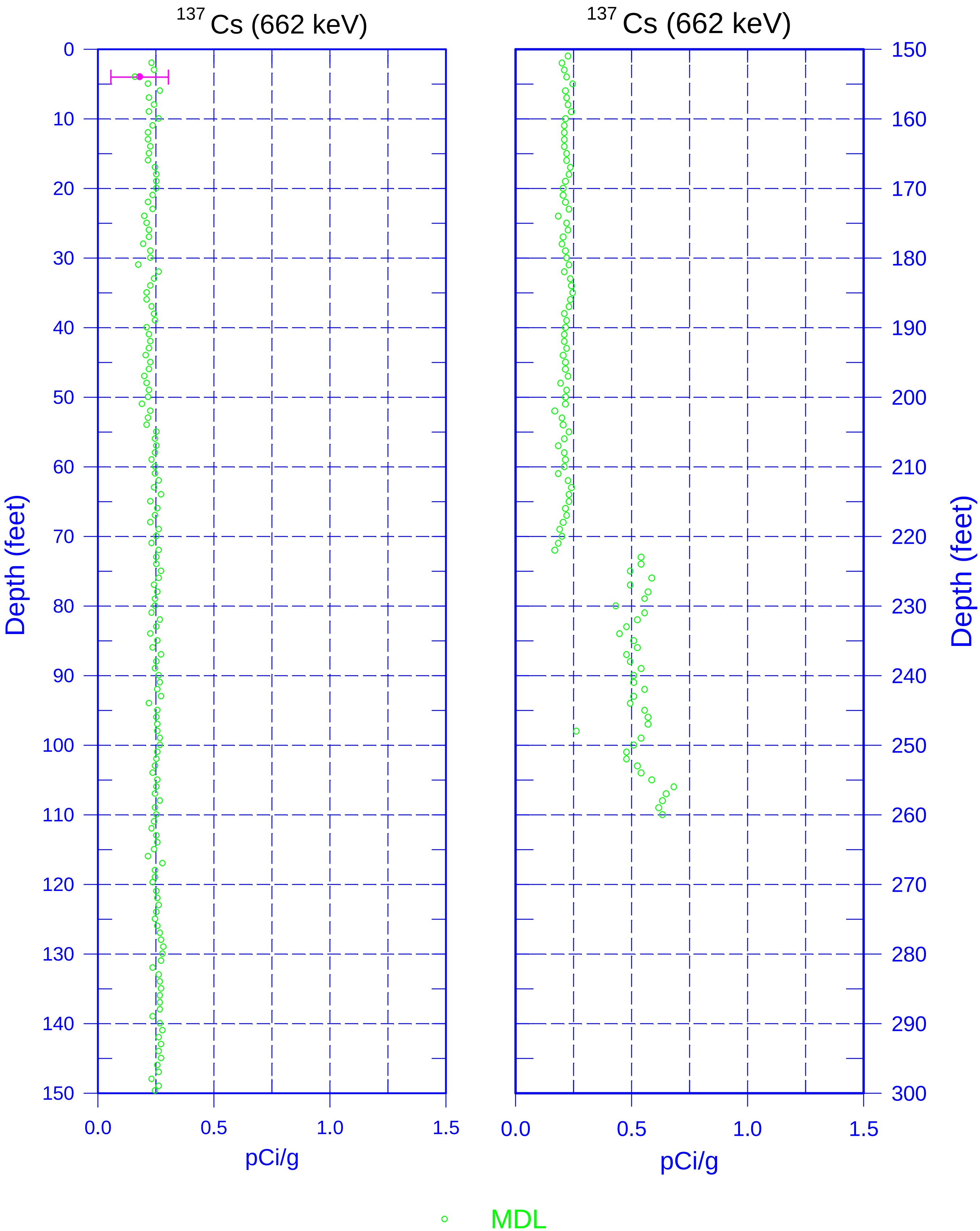
Below 222 ft, the apparent increase in ^{238}U activity based on 609-keV spectral line of about 1.0 pCi/g is greater than the apparent increase in ^{238}U activity based on 1764-keV line of about 1/4 pCi/g. This apparent increase in ^{238}U at groundwater may be the result of dissolved radon (^{222}Rn) in the water, an incorrect water correction factor, or a combination of both. The apparent concentration based on the 609-keV peak appears to increase more than that based on the 1764-keV peak because the water correction factor decreases with increasing energy level. If the source of the gamma photons is within the water, then there is less attenuation than would be expected, and the effect of the water correction is an apparent increase in the calculated concentration. Alternatively, the water correction factor may be too high, resulting in the apparent increase. At this time, the apparent increase in ^{238}U at groundwater is under review, and the water correction will be changed if necessary.

The highest neutron counts occurred in the groundwater as expected. The comparison of the neutron data with the SGLS data is complicated by the differing vertical resolution of the two data sets. The sample interval of the neutron-moisture log is 1/4 ft versus 1 ft for the SGLS. Thus, the neutron log has a finer vertical resolution than the SGLS logs.

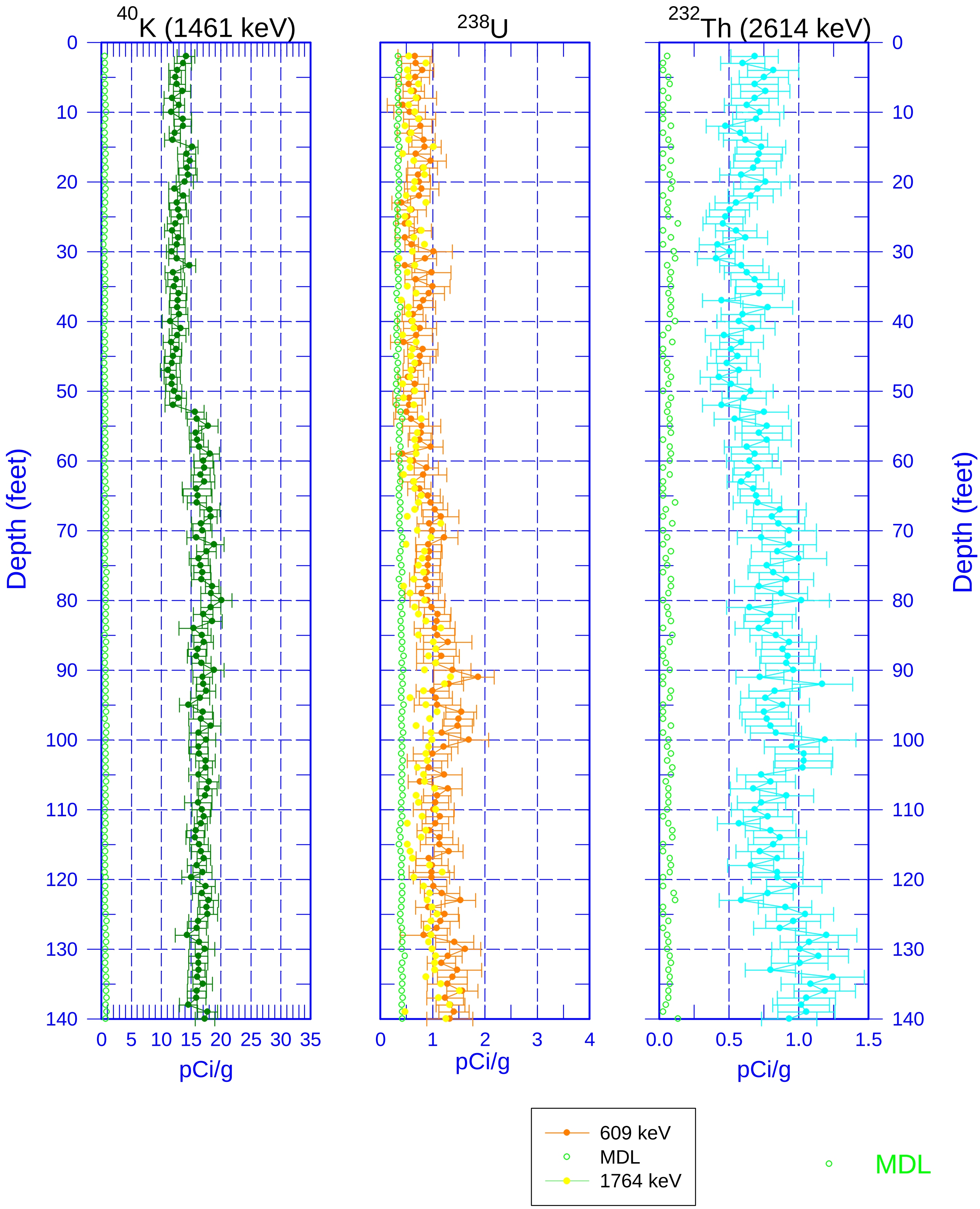
Reference: Randall, R., 2001. *Certificate of Calibration RLSM00.0*, July 11, 2001, Three Rivers Scientific, Richland, Washington.

[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not applicable

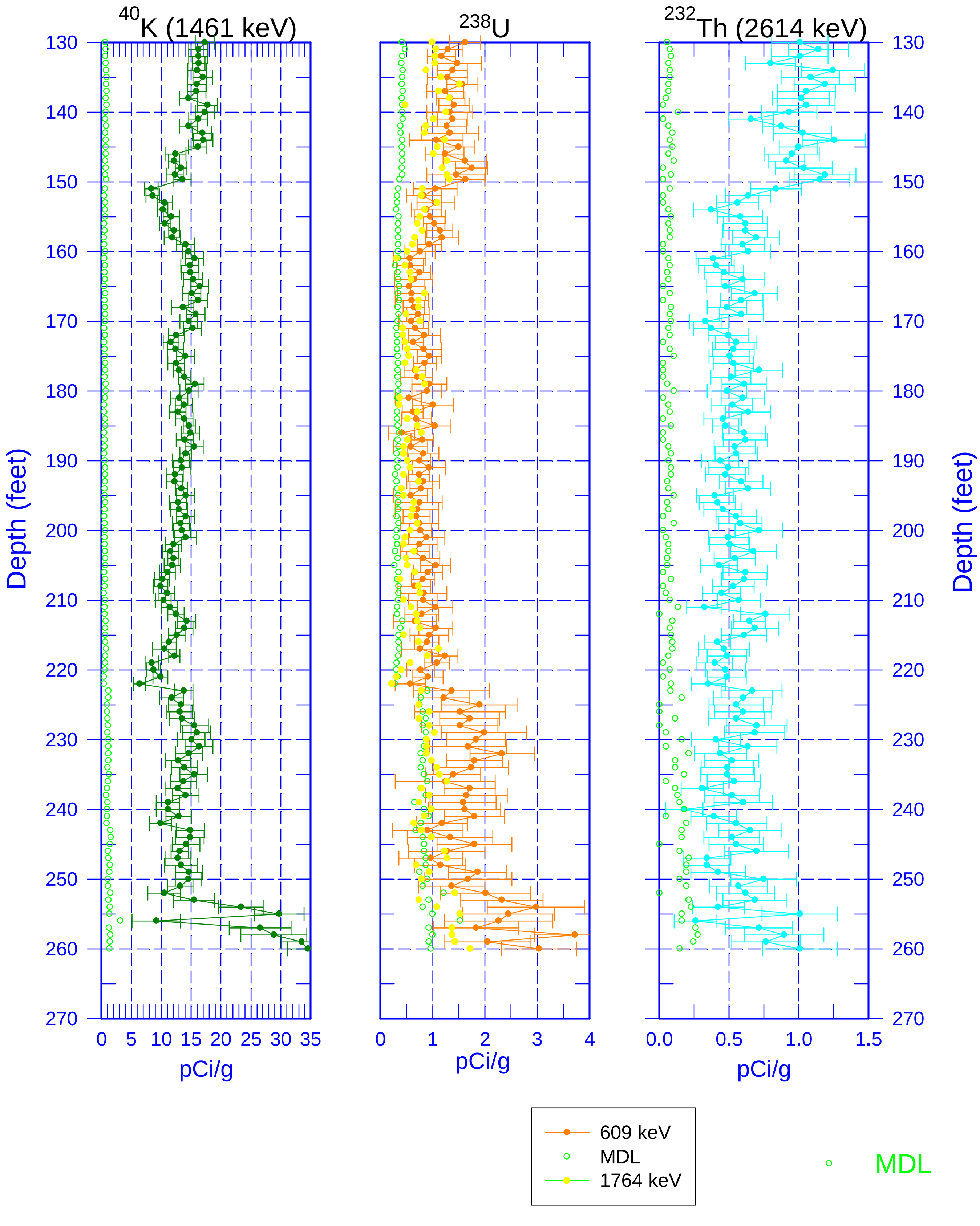
299-W22-85 (C3399)
Man-Made Radionuclide Concentrations



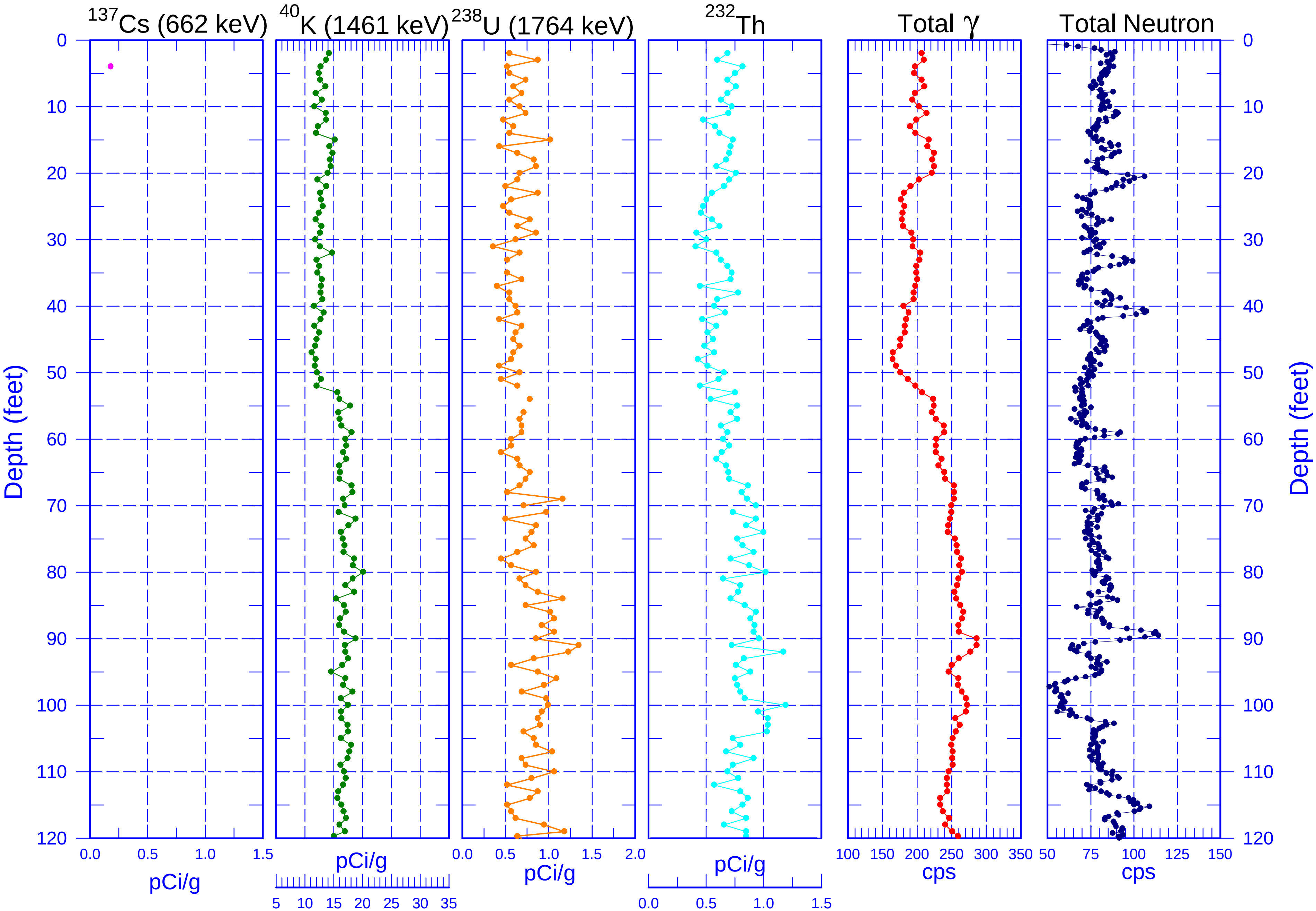
299-W22-85 (C3399)
Natural Gamma Logs



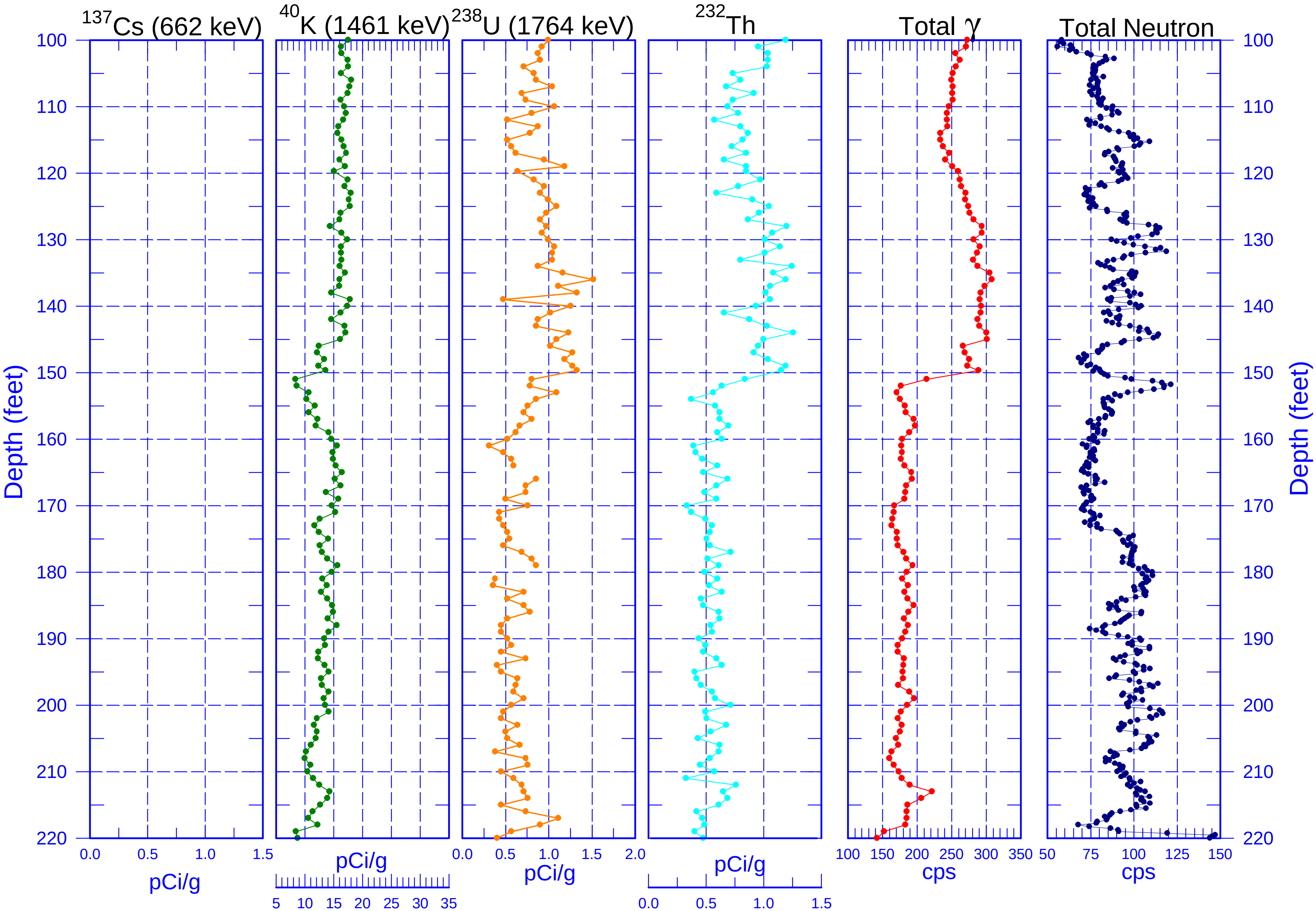
299-W22-85 (C3399)
Natural Gamma Logs



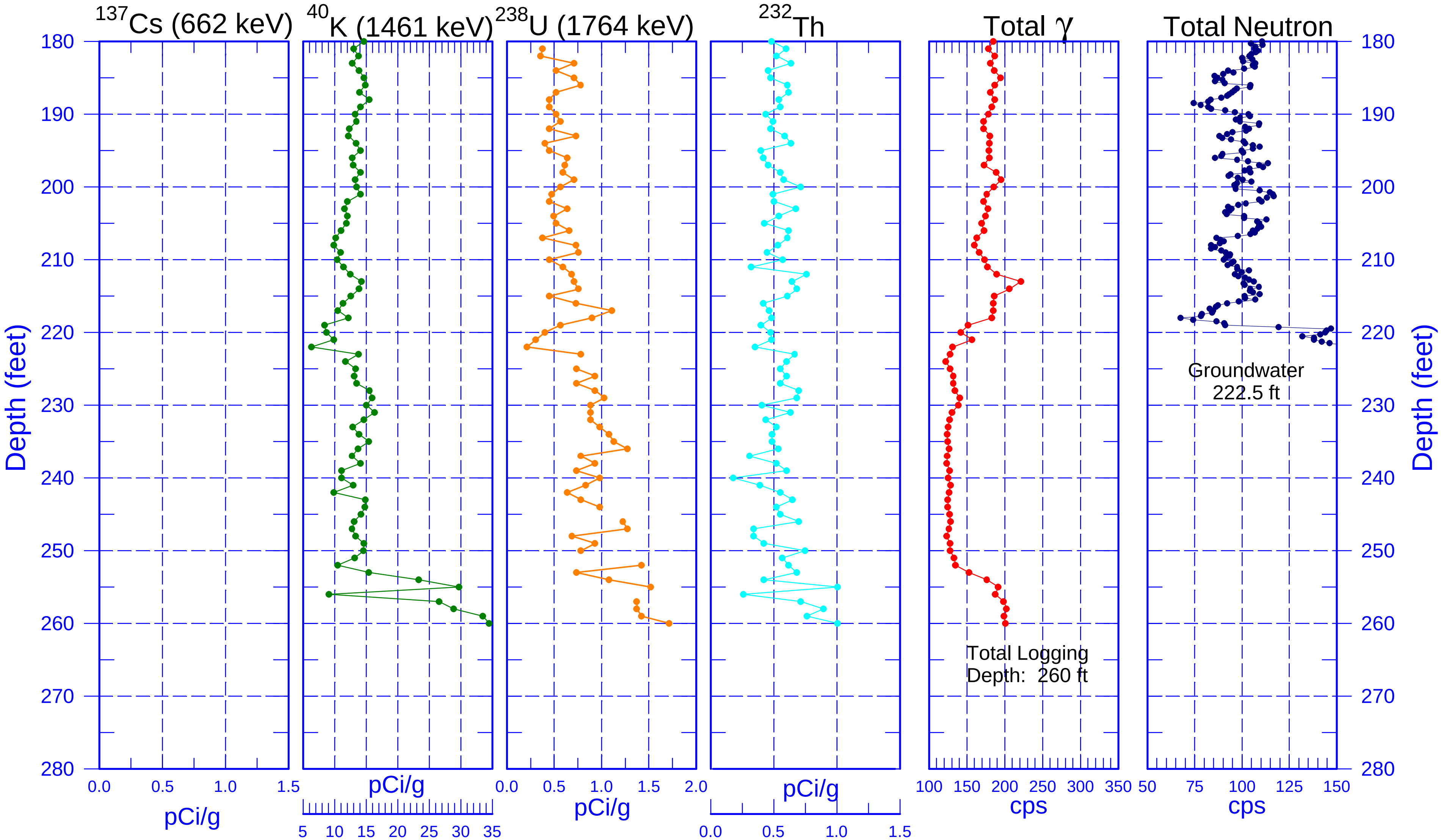
299-W22-85 (C3399) Combination Plot

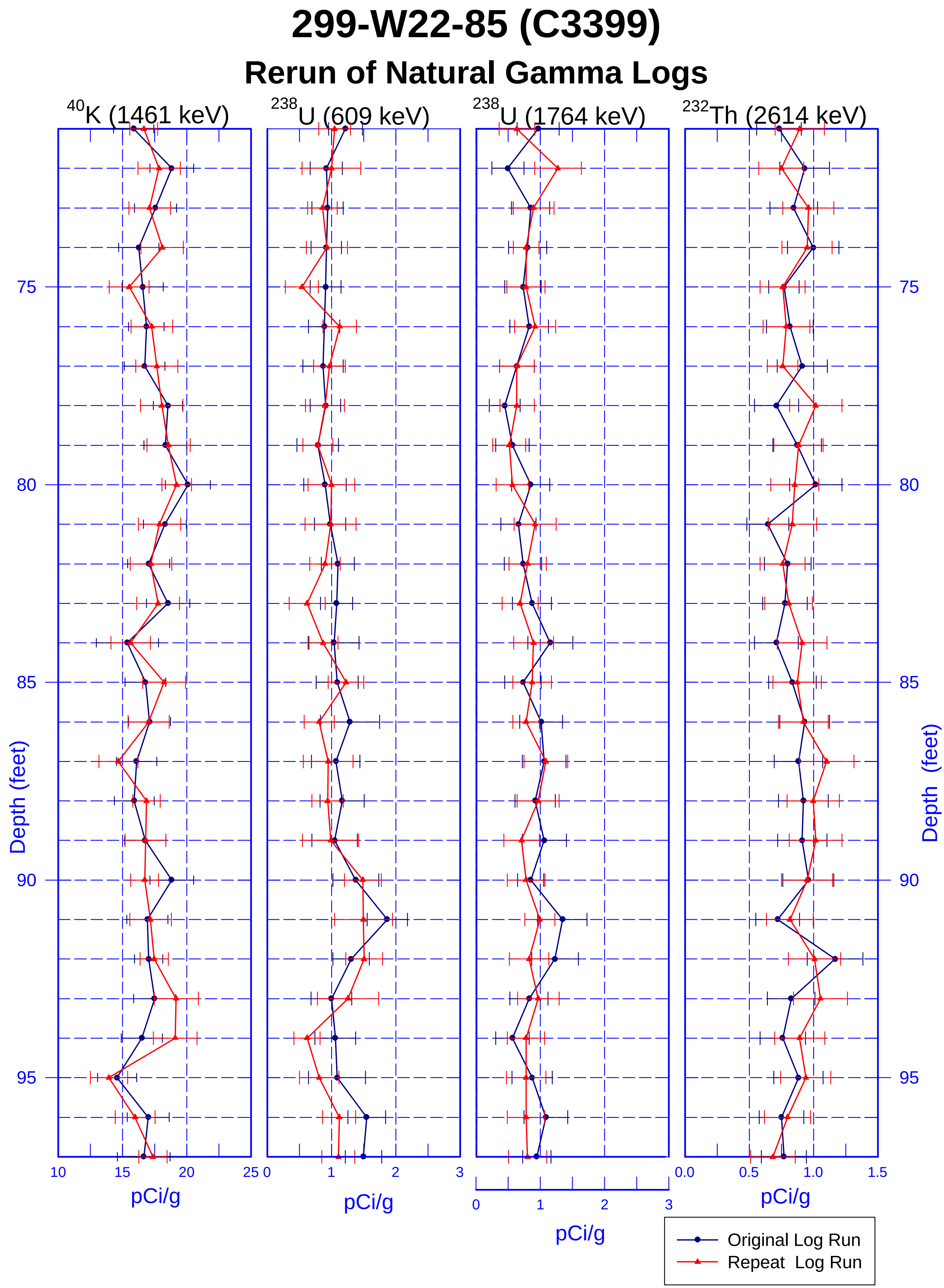


299-W22-85 (C3399) Combination Plot



299-W22-85 (C3399) Combination Plot

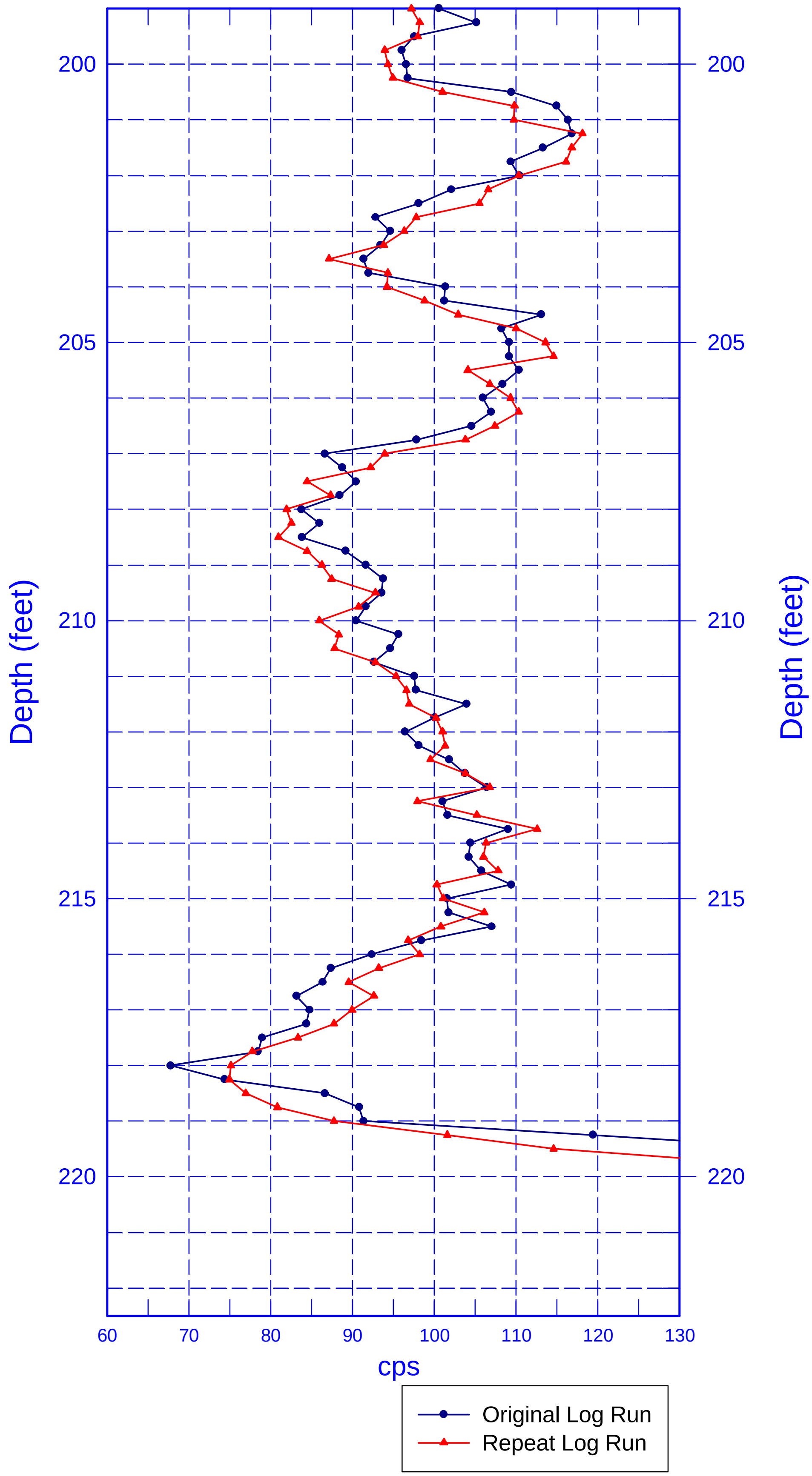




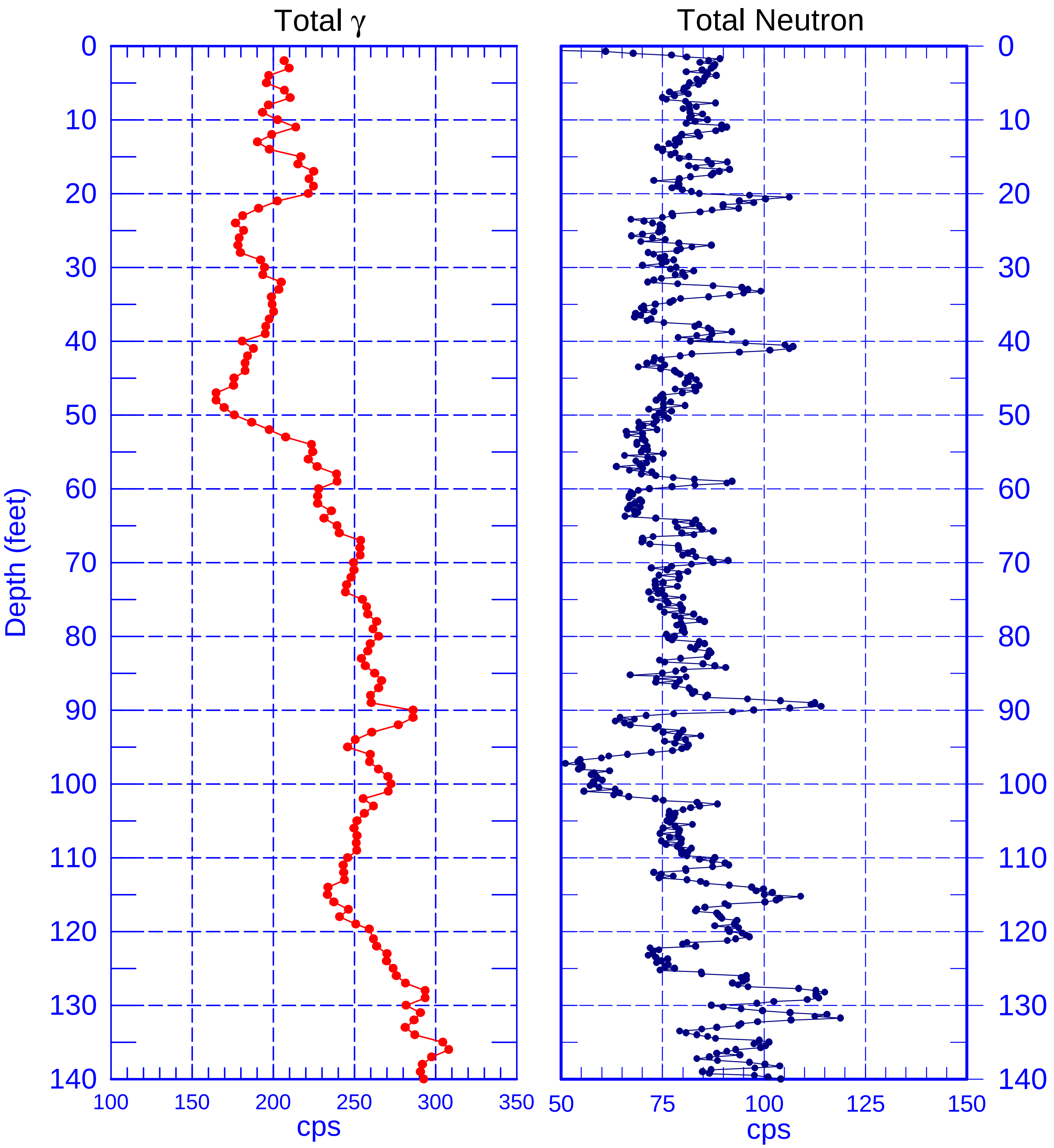
299-W22-85 (C3399)
Rerun of Natural Gamma Logs
40K (1461 keV)
238U (609 keV)
238U (1764 keV)
232Th (2614 keV)
Depth (feet)
75
80
85
90
95
10
15
20
25
0
1
2
3
0.0
0.5
1.0
1.5
pCi/g
Original Log Run
Repeat Log Run

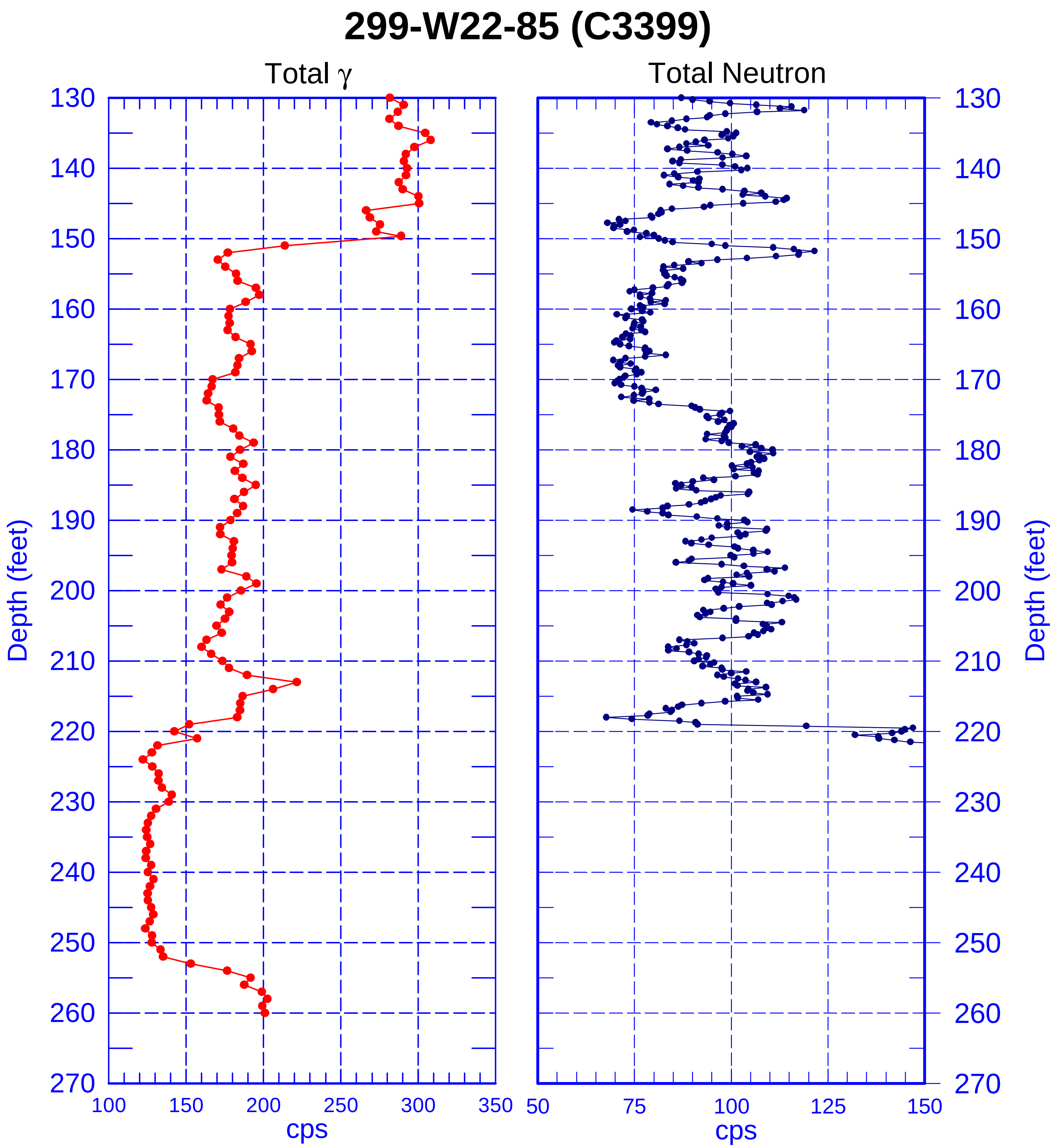
299-W22-85 (C3399)

Rerun of Neutron-Moisture Log
Total Neutron



299-W22-85 (C3399)




299-W22-85 (C3399)
Total γ
Total Neutron
Depth (feet)
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
100
150
200
250
300
350
cps
50
75
100
125
150
cps
Depth (feet)